

Bipolar transistor, semiconductor device and method of manufacturing same

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The invention relates to a bipolar transistor comprising

- a collector region with a first doping type,
- a base region with a second doping type,
- and an emitter region with the first doping type,
- 5 - a junction being situated between the emitter region and the base region, and, viewed from said junction, a depletion region extending in the emitter region,
- and, said emitter region comprising a layer of a first semiconductor material and a layer of a second semiconductor material.

The invention also relates to a method of manufacturing a bipolar transistor
10 comprising a collector region with a first doping type and a base region with a second doping type, on which an emitter region with the first doping type is formed, said emitter region including a layer of a first semiconductor material and a layer of a second semiconductor material.

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US-A 535912 discloses a bipolar transistor that can suitably operate at high frequencies. Said bipolar transistor has a cutoff frequency of typically 100 GHz, as a result of which the transistor can suitably be used as a component in optical communications networks for transporting 40 Gb/s.

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The bipolar transistor is made from silicon and includes a base region with a $\text{Ge}_x\text{Si}_{1-x}$ strained layer. As the bandgap of $\text{Ge}_x\text{Si}_{1-x}$ is smaller than that of Si, with the conduction band coinciding with that of silicon, and the valence band energetically moved by ΔE_v with respect to the valence band of Si, the charge storage in the base region and the emitter region is reduced relative to silicon bipolar transistors at comparable current levels. In
25 order to maximize the speed of the transistor, the percentage of Ge in the base region is as high as possible.

In the known bipolar transistor, the charge storage in the emitter is also reduced, which can be attributed to the fact that the bandgap, viewed from the junction, decreases linearly in the direction of the emitter contact. During operation of the bipolar